wooden wedge succeeded in separating his front teeth about half an inch, but that it irresistibly contracted as the wound closed. On the whole, the case too nearly resembles the one related by Professor Mott, in No. IX. p. 102 of this Journal, to need any further description. I proposed the same operation as there described, but the patient objected to having his cheek cut through. I therefore varied the operation so as to save the cheek entire, and am induced to believe that this is an improvement worthy of notice; for, independent of its saving at least *some* pain, it leaves the face free from scars, and there is no danger of the breaking of stitches and slipping of adhesive straps during the cure.

The patient being seated in a chair in a strong light, his lips separated and firmly held by assistants, I passed a very sharp two-edged knife, flatwise, in the direction of the teeth, back to the angle of the jaw, and carefully dissected the morbid adhesion from the gums; I then turned the edge so as to cut through the hardened mass crosswise, and as far back as I could. This so far loosened the jaw as to admit the *vice* betwixt the first molar teeth, and I then expected that a trifling force would be sufficient to finish the operation, but I have no doubt that the force applied was equal to one hundred pounds, and when it yielded it was attended with an audible crash resembling the laceration of ligaments. By keeping the jaws asunder by a wooden wedge, and the cheek from the gums by a soft sponge for a few weeks, the patient completely recovered the use of this jaw and the natural shape of his face.

Minot, Maine, June, 1831.

Art. IV. *On the Adaptive Powers of the Eye.* By H. Morton, M. D. of New York.

THE functions of the organ of vision have engaged the attention of anatomists and physiologists to a greater extent than any other organ in the animal economy. Its general anatomy is sufficiently well understood, but its physiology, we are inclined to believe, has not kept pace with the general advancement of medical science. Its functions as a dioptical instrument, or an organ of vision, offers a considerable field for observation and experiment, and a more accurate knowledge of these functions would perhaps enable us to explain more satisfactorily a great variety of its phenomena that are now obscure. Such knowledge might also enlighten us on its pathology, both surgical and clinical, and as it is the organ through the medium of which the mind acquires by far the greatest proportion of its ideas, it might not be without its influence in a metaphysical point of view.

We find in the human species, as well as in most of the lower orders of animals, two organs of sight, but which, as regards the function of vision, should nevertheless be considered as *one single organ;* their analogous distribution of nerves and muscles, their perfect unison in motion depending upon this distribution, the necessity there seems to be that objects should be painted upon the same relative part of the retina of each eye, appears to indicate that nature has constituted them *one organ.* Whether this unity of function could be extended to the microscopic eyes of insects, our present knowledge of comparative anatomy will not permit us to decide.* In the human subject, however, it is evident.

The general phenomena of vision is sufficiently well explained by the present known laws of optics. It is known that rays of light proceeding from objects or bodies, after passing through the different humours of the eye, and having undergone certain changes as regards their direction and colour, are received upon the retina or expansion of the optic nerve, and there form an image resembling the object from which they emanated; the image, however, is much smaller than the object, and inverted. These facts are sufficiently proved by the examination of the recent eye of an animal, and also by instruments constructed to resemble the human eye; but upon examination we will find that the eye, however recent it may be, has lost its adaptive powers,† and optical instruments we know must undergo certain adjustments for their proper adaptation. In both cases the focal distance of the lens must be changed, either by motion in itself, which is a theory advocated by many—or else its relative position as it regards the retina must be altered—or, which is equivalent, the retina or screen upon which the image of the object is received, must either approximate or be removed further from the lens, according as the object viewed is nearer or more remote, unless the organ or instrument be adapted for parallel rays. It is presumed that there is a mechanism by which the animal eye is thus enabled to adapt itself to points of vision at different distances; yet there are some ingenious men who can see no necessity for this power and would explain the function as the result of habit and attention. Notwithstanding, however, the subject has received a great deal of attention, and a great many truly ingenious and interesting experiments have been made, they seem to have tended rather to expose the errors of other theories than to establish the true one.

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* Our own organ may be rendered microscopic by substituting for the natural pupil, (which cannot be brought to the requisite degree of minuteness,) an artificial opening. If a piece of card be perforated with an ordinary sized pin, and vision directed through it, distinct vision of minute objects may be obtained within half an inch of the cornea. We find nature has adopted the same mechanism in the formation of the eyes of the chamelion; it feeds upon minute insects, and its pupil is so small as to be scarcely visible to the naked eye. "La fente est d'ailleurs si petite qu'on voit à peine sa prunelle au travers."—*Cuvier, Anat. Comp. d'Œil.*

† The observation of M. Majendie upon the dead eye of an animal is equally true of the camera obscura; in fact, the recent eye is no more than a perfect camera obscura, and in both cases the distinctness of the image will be increased by adapting a pupil of the requisite diameter, and supposing the image on the retina of the recent eye is equally distinct when directed to near and distant objects, yet as we are ignorant of the precise degree of distinctness requisite for vision, no certain inference could be drawn from this fact. If the same thing occurs in the living eye that M. Majendie and others have observed

The eye is unquestionably the most complicated organ in the whole system, and therefore an explanation of its functions necessarily demands an intimate knowledge of all its complicated parts; not merely the general laws of optics applicable to it, but also its minute anatomical structure, as well as the physiological sympathies existing between its different parts. To consider the eye as a mere optical instrument, or even the most perfect "camera obscura," which it certainly very closely resembles, would by no means lead us to an *accurate* knowledge of its general functions, and least of all the peculiar function we are now considering.

In comparing the eye to any optical instrument made to resemble it, we should conclude that the skill and power which formed the one, endowed it with properties which it would be absurd to expect to find in the other. Omniscient skill and Omnipotent power was exercised in forming the human eye and adapting its various parts to harmonize in action, while the optician's instrument, how-

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in the dead, that is, all objects, whether near or remote, are equally distinct in outline upon the retina, where will we find an explanation of the fact, that in vision near objects are actually more distinct than distant ones. It seems only to increase the difficulty, whereas, if we admit that near objects are rendered more distinct by a certain adaptation of the eye, (which can be proved even on the recent subject, by making use of a diaphragm having an opening of the requisite diameter,) we at once can account for the different distinctness of near and distant objects.

ever perfect it may be, is, after all that human ingenuity can suggest, but an imperfect imitation of its model.

Among the variety of opinions entertained respecting the adaptive powers of the eye, that appeared the most satisfactory at the time, which supposed an alteration in the spherical form of the eye produced by the action of the recti muscles, whose consentaneous action either lengthened or shortened its axis. The great and permanent convexity of the cornea in near-sighted persons seemed to favour this idea, and it was inferred that a palpable motion productive of this effect would be detected upon examining an eye while in the act of adapting itself to points of vision at different distances. Experiments were therefore made to establish this fact; the eye of an individual was observed through a microscope in such a manner that the slightest motion, if any, would be detected, but no motion adequate to the requisite effect could be observed. Neither could it be fairly inferred that the great convexity of cornea in near-sighted persons was the cause of their defect of vision, for in the ingenious experiment of Dr. Young, the eye, (although the influence of the cornea was destroyed,) still retained its adaptive powers. That a very great degree of convexity in the cornea would be attended with a certain defect, as it regards the adaptive power, is possible; such might be the case in congenital malformation; but it can scarcely be considered as the cause, when this defect is consequent or depending on constitutional derangement, too violent or long-continued action of the organ, or when the eye has been subjected to too intense a degree of light, or even in sudden transitions from one medium of light to another, when the eye, at least for a time, loses its adaptive powers. Cases analogous to those enumerated frequently come under the observation of medical men. A patient now under my care, until the age of thirteen, possessed the ordinary range of vision, but too close application to study together with confinement, brought on constitutional derangement, and upon convalescing this defect of vision was observed, and has continued for a number of years; at the present time occasional indisposition has an evident influence on the adaptive powers of the eye. Mr. ANNESLEY states that hemeralopia or night cecity, is especially prevalent among the people of India, and he considers it as owing to accumulations of morbid secretions in the primæ viæ, and is always remedied by free purgation.

From observing the fact that a double concave lens would remedy the defect in a near-sighted eye by counteracting, as it was supposed the too great convexity of the cornea, it would appear that the chief attention of experimenters had been diverted from the other structures of the eye, and led them to seek for the explanation of the power of adaption, in the alteration of convexity in the cornea alone. Now there are some instances where no undue convexity can be observed, and yet the eye has not the power of adapting itself to distant vision. We frequently find artists who are in the habit of using one eye only on minute objects, in process of time become near-sighted in the eye so used. If we observe attentively the eye of a near-sighted person, when directed to distant objects, and fix our attention upon the iris, we shall find, when a lens is placed before the eye, that the diameter of the pupil is gradually altered, the iris shortly becomes stationary, and until this change in the iris has been effected vision is not distinct; evidently proving that a certain change must take place in the eye, notwithstanding the aid of the artificial lens.

The influence of the iris in regulating the admission of light did not escape the observation of the earlier anatomists; it was observed invariably to expand in an intense, and contract in a less vivid light. If the eye be directed for a moment towards the sun, the pupil attains its least diameter. The reverse takes place in the entire absence of light—the pupil is enlarged to its greatest extent. Such a provision was necessary to guard the delicate organ from the effects of intense light, but experiment and observation would lead to the conclusion that the iris, besides possessing this instinctive power of self-preservation, influences directly the function of vision, that while it excludes from the eye too intense a light, at the same time it has the power of admitting only such rays as are necessary for distinct vision. We might consider the iris as acting under two kinds of sensibility, or perhaps mere modifications of the same sympathy—that sensibility which protects the retina from too much light, and that *visual* sensibility, (if we may be allowed the term,) which, when the iris has adapted itself to the intensity of light in the surrounding medium, adapts the pupil to the admission of only those rays which are requisite for distinct vision. To be assured of this we have only to observe the eye while performing its function of vision, when it is directed generally to a distant prospect; the iris is adapted to that degree of light consistent with its normal function, but the instant an object is singled out in the distant prospect, we can observe a sensible alteration in the diameter of the pupil, the result of a new impulse, and on closer observation the iris will be found to vacillate as the object singled out is more or less *distinctly* seen; or perhaps it would be more correct to say, the object becomes more or less distinct in accordance with the motion of the iris. The motion of the iris when objects are viewed at different distances has been observed, but sufficient importance has not been attached to it. Under the influence of solar light, this visual sensibility of the iris is much less apparent than in its absence; its motion, however, is sufficiently evident even to the naked eye, but in a more obscure light it is palpably manifest.

A case is related by Mr. TRAVERS, in his work on the eye, of an individual who possessed directly a voluntary power of adapting the eye. We are inclined to believe that to a certain extent this power is possessed by most individuals; that is, objects at any point of vision may be rendered indistinct by what would appear to be a very slight exertion of the two internal recti muscles, and if the iris be observed at the same time, it will be found to vacillate, contracting or enlarging as the object becomes distinct, or the contrary. It is true, this motion in the iris, though observable, is not as extensive as when the eye is directed, by candle-light, in quick succession from distant to near objects, and might leave a doubt whether so slight a change in the diameter of the pupil would be adequate to produce the effect.* A consideration of the form and action of the iris, together with the peculiar properties of the crystalline lens, will perhaps leave less reason to doubt the influence the iris possesses of regulating the visual rays proceeding from objects at different distances.

A great deal of minute investigation has been made for the purpose of deciding the question, whether the iris, properly speaking, can be considered a muscle. It appears to be a matter of no very great importance whether we rank it as a muscle or not, provided we can ascertain its structure and function: at any rate, we find it endowed with some of the properties peculiar to muscular fibre, and it is sufficient for our present purpose to consider it as such. It is certainly a tissue endowed with peculiar properties; its sympathies or sensibility is peculiar to itself. Anatomists describe it as a flat, circular muscle, perforated in the centre; this description would be strictly accurate only in autopsic examinations, but will not accord with its actual form in the living animal, especially during its state of dilatation, for then it may be considered rather a funnel-shaped muscle, resembling the surface of an extremely obtuse truncated cone, its top or apex being the pupillary margin, its base the edge inserted or arising from the circular margin of the choroid coat. In the living subject, the pupillary margin is somewhat in advance or anterior to its base or origin, and corresponds in direction with the anterior convexity of the crystalline lens. This peculiar conformation gives to the iris a controul over the admission or exclusion of rays of light, as it regards the lens, which would not obtain were it either a flat muscle, or its points of origin and insertion reversed. This peculiar mechanism enables the iris in the most expeditious and effectual manner to exclude all collateral and unnecessary light, and at the same time admit such rays as come in direct lines from the object viewed, and confines them to the central portion of the crystalline lens. Had its base or insertion been anterior to its pupillary margin, it is evident that the diameter of the pupil could not have been adapted to receive the direct rays proceeding from objects, without at the same time admitting an undue and unnecessary quantity of light within the eye; had it been a perfectly flat muscle the same difficulty, though to a less extent, would necessarily follow. Its present form and action, is, like all the works of nature, a master-piece of mechanism, and calculated in the most perfect and admirable manner to produce the desired result.

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* I have, however, frequently been able, while observing the eye of an individual in this condition, to inform him when his vision was distinct or indistinct, by merely observing the changes in the diameter of the pupil.

The action of the iris, its contraction and dilatation, should perhaps be viewed as a motion "*sui generis*," for there appears to be no other muscle in the system precisely analogous to it. In considering muscular action, we are accustomed to connect the ideas of the origin, insertion, and fulcrum of each muscle, and from thence infer the intended result or effect produced by their contraction, but in the iris we find only its origin, unless we consider its pupillary margin as its insertion, but even then we want a fulcrum; in fact, its muscular motion is peculiar to itself; the tongue is the only muscle analogous to it in action, for after protruding the tongue beyond the teeth, as far as the motor muscles attached to its root and inferior surface will permit, we still have the power of elongating and of moving in different directions the end or tip to a considerable extent. This power is possessed in a much greater degree by many of the lower orders of animals—the cow, sheep, dog, &c.; the cow can thrust its tongue a considerable distance within the nostrils; it is, we conceive, an analogous species of muscularity by which the leech and common earth-worm are enabled to move.

Such being the admirable mechanism of the iris, we shall have less hesitation in admitting that a very slight alteration in the diameter of the pupil will be fully adequate, not only to regulate the proper quantity of light, but also controul the admission of the necessary visual rays. It may appear, however, more satisfactory after taking into consideration the peculiar properties of the crystalline lens. It will be sufficient for that purpose to consider the lens of the human eye as a transparent substance, having its two surfaces composed of equal segments of the same sphere, and consequently will possess the common properties of the optician's instrument, denominated the double convex lens; its actual form, according to Petit, is that of a compressed sphere having its anterior surface the segment of a greater sphere, its posterior the segment of a less. The changes, as it regards direction, that rays of light undergo in passing through a dense medium of this configuration, can be ascertained by experiments upon the artificial lens with a sufficient degree of accuracy to enable us to draw conclusions relative to the powers of the natural lens of the eye. The general properties of a double convex lens are, that rays of light which pass through it *furthest* from its centre or axis, are made to converge the soonest, and those rays which strike *nearest* to its centre or axis converge the least. All parallel rays in passing through the lens have the greatest focal distance, and it is this point, the focal distance of parallel rays, by which opticians designate the power of their different lenses, calculated either by the convexity of the sphere, of which they are a segment, or else from actual measurement, by receiving the rays of light from the sun, which rays may be considered as parallel, owing to its distance.

According to the known laws of optics, rays of light proceeding from objects at different distances, after passing through a double convex lens, are brought to different foci, the rays of light from the more distant objects being parallel, have necessarily the longest foci; the same object, if brought nearer the eye, and seen in its full magnitude, must be seen by converging rays, the focal distance of which, according to the laws of optics, would be less than when the object was more remote, and consequently in one or the other instance vision would be defective—if distinct in the remote, it would be indistinct when the object was brought near, or the reverse. Such would be the case in an eye wanting an iris; such we find is the case in optical instruments, the "*camera obscura*," &c.; the defect in either can be remedied by the same or nearly similar means. The iris being capable of contraction or dilatation, accommodates the pupil to the admission of only a certain number of the more parallel or direct rays whose focal distance is uniform, and at the same time excludes all indirect or collateral light, which, if admitted, would only tend to render the image indistinct. In the camera obscura the same effect may be produced by substituting for the iris artificial diaphragms; in the instrument now before me, though imperfect in its construction, the screen upon which the images are formed, may be moved considerably beyond the focal distance of the lens, so that no objects whatever appear upon it, and by interposing an artificial pupil of a certain diameter, objects become apparent. It would appear that the interposition of the iris, while it excludes a portion of the indirect rays, confines those that are admitted to the central part of the lens, where they consequently undergo less refraction than if they were suffered to be acted upon by parts further from its centre or axis, and consequently have their focal distance increased. The opinion entertained by Mr. Travers on the adaptive power of the eye, was based upon the supposition of a change of figure in the crystalline lens. He supposed it an elastic body, influenced by the muscular action of its surrounding parts, and that both its figure and site were changed, whereby its refractive powers were increased or diminished. Now, the influence of the iris renders such a supposition unnecessary, because the diameter of the pupil alone will controul or alter the refractive power of the lens, as it regards certain rays, by admitting the rays of light to be acted upon by different parts of the lens possessing at all times different powers of refraction.

The field of *distinct vision* is extremely limited, scarcely perhaps the twelfth of an inch as it regards the retina; if we observe a person while reading, we see the axis of the eyes successively moving from point to point, and can observe, even in our own case, that if we attempt to view distinctly two points, distant from one another the eighth of an inch, we feel sensible of an evident exertion in the muscles of the eye to direct its axis from the one point to the other. In viewing a distant prospect the eye possesses a much greater range, but is also much less distinct, and individual objects in this prospect can only be rendered more distinct by directing the eye to a limited and circumscribed point, and the rays of light emanating from that point must necessarily pass through the more central portions of the crystalline lens.

The perfect structure of the crystalline lens, together with its surrounding mechanism, give to it additional powers; it is composed of concentric lamina differing in density, (and consequently in the powers of refraction,) from the centre to the surface; it is contained within a transparent capsule, between which and the lens is a peculiar fluid, denominated the liquor Morgagni. From its anatomical structure an optician would infer that it was the most perfect instrument of its kind, and the immense extent of vision, from a few inches to millions of miles, would confirm the opinion. Artificial lenses are subject to certain errors, denominated by opticians the caustic curve, by refraction or spherical aberration; from the established laws of matter, the crystalline lens would be subject to the same error to a certain extent; this defect is counteracted in a measure by its structure, but chiefly by the interposition of the iris; the structure of the lens, aided perhaps by the other humours of the eye, the aqueous, vitreous, &c. render the organ perfectly achromatic. To avoid these various defects, opticians have endeavoured to imitate nature by combining two plano-convex lenses, and interposing a diaphragm between the two plane surfaces; in this, however, they have imitated nature imperfectly, for in the one it is fixed and immoveable, while in the other it is not only possessed of motion, but a motion in every respect subservient to the function of distinct vision, as well as the preservation of the organ. In adapting the spyglass for the view of distant objects, it becomes necessary that the lenses made use of should be brought to their respective focal distances, which is effected by elongating the tube; at the same time this produces an analogous effect to that of introducing a perforated diaphragm, for as the tube is elongated, and the lens removed from the object part of the instrument, the *virtual* diameter of the orifice is diminished, or the range of vision lessened, because those rays of light which would have struck the lens, if near the object orifice, when it is removed further from it do not even reach it, and if placed sufficiently remote, will effectually exclude all but the more direct and parallel rays, which we think are those chiefly concerned in *distinct* vision.

As it regards the defect of vision in near-sighted eyes, as well as that change which is found to take place in old age, it would appear that too much importance has been attached to the influence of the cornea, and accounted for by the action of the recti muscles, and in old age by the absorption or diminution of the different humours. I have frequently examined the corneas of near-sighted persons, where not the slightest degree of undue convexity could be detected; and on the other hand, I have seen many who had unusually convex corneas, and yet did not labour under the defect usually attributed to this peculiar conformation. I have recently had this observation confirmed in the instance of an individual under my care, whose cornea was so extremely convex, that when the eyelids were closed, it formed a protrusion elevating the lid several lines above the sclerotic surface, and evident at a considerable distance when the eye was closed and made to roll in its socket; the adaptive powers of the eye were nevertheless unusually perfect. There are, no doubt, many instances where this defect of vision is accompanied with a great convexity of cornea, but it does not necessarily follow that it should be the cause of it.

This great convexity of cornea, which in the human species is considered a defect, is found to exist in many animals that seek their prey by night. All the animals of the species "Felis" are remarkable for their acuteness of vision; "the eye of the lynx" has become proverbial; like the domestic cat, their corneas being the segment of a smaller sphere, may perhaps be considered much more convex than that of the human eye, but the perfection of their organ would seem to result from the expansive and contractile power of the iris. The immense play of the iris in the domestic cat, and the acute sensibility of the retina to light, is truly astonishing; now the owl does not possess an equal play of the iris, and we find in the broad glare of daylight they see but dimly if they see at all. There is no doubt but the pliancy or mobility of the iris may be increased by practice; we find that artizans constantly engaged in minute work, provided they do not use an artificial lens have the microscopic powers of the eye greatly increased; but the constant and long-continued action of the iris deprives it of the power of requisite contraction for distant vision; and again, sailors who are much accustomed to discern distant objects, and use their eyes a great deal by night, have their respective powers much more developed and perfect.

The pathology of the organ of vision affords a great number of facts which would seem to strengthen the opinion as it regards the influence of the iris in the proper adaptation of the eye. In the fifth vol. of the Medico-Chirurgical Review a case is related of total, though temporary blindness, attended with excessive enlargement of the pupil, and we know that sudden fear produces a similar effect upon the iris, and attended with the same defect of vision. In most cases of "iritis," indistinctness, followed by total loss of vision, commences with the irregular contractions of its muscular fibre; and after the operation for artificial pupil, when the iris has lost its powers of contraction and dilatation, the eye also loses its adaptive power, and requires the aid of artificial lenses. If the irregular contractions of the iris render vision indistinct, it would be important in the operation for artificial pupil, to take into consideration not only the requisite or most convenient diameter of the pupil, but also its form and situation; for Mr. Guthrie in his work on artificial pupil, remarks, that the more the rays of light are directed to the central portion of the lens, the powers of vision are much more augmented than when the artificial pupil is made so large that rays are admitted upon its circular margin. Indeed opticians are generally agreed that only the central portion of their lenses are of use, and by the adoption of diaphragms, they render useless, as it regards the transmission of light, by refraction or spherical aberration; from the established laws of matter, the crystalline lens would be subject to the same error to a certain extent; this defect is counteracted in a measure by its structure, but chiefly by the interposition of the iris; the structure of the lens, aided perhaps by the other humours of the eye, the aqueous, vitreous, &c. render the organ perfectly achromatic. To avoid these various defects, opticians have endeavoured to imitate nature by combining two plano-convex lenses, and interposing a diaphragm between the two plane surfaces; in this, however, they have imitated nature imperfectly, for in the one it is fixed and immoveable, while in the other it is not only possessed of motion, but a motion in every respect subservient to the function of distinct vision, as well as the preservation of the organ. In adapting the spyglass for the view of distant objects, it becomes necessary that the lenses made use of should be brought to their respective focal distances, which is effected by elongating the tube; at the same time this produces an analogous effect to that of introducing a perforated diaphragm, for as the tube is elongated, and the lens removed from the object part of the instrument, the *virtual* diameter of the orifice is diminished, or the range of vision lessened, because those rays of light which would have struck the lens, if near the object orifice, when it is removed further from it do not even reach it, and if placed sufficiently remote, will effectually exclude all but the more direct and parallel rays, which we think are those chiefly concerned in *distinct* vision.

As it regards the defect of vision in near-sighted eyes, as well as that change which is found to take place in old age, it would appear that too much importance has been attached to the influence of the cornea, and accounted for by the action of the recti muscles, and in old age by the absorption or diminution of the different humours. I have frequently examined the corneas of near-sighted persons, where not the slightest degree of undue convexity could be detected; and on the other hand, I have seen many who had unusually convex corneas, and yet did not labour under the defect usually attributed to this peculiar conformation. I have recently had this observation confirmed in the instance of an individual under my care, whose cornea was so extremely convex, that when the eyelids were closed, it formed a protrusion elevating the lid several lines above the sclerotic surface, and evident at a considerable distance when the eye was closed and made to roll in its socket; the adaptive powers of the eye were nevertheless unusually perfect. There are, no doubt, many instances where this defect of vision is accompanied with a great convexity of cornea, but it does not necessarily follow that it should be the cause of it.

This great convexity of cornea, which in the human species is considered a defect, is found to exist in many animals that seek their prey by night. All the animals of the species "Felis" are remarkable for their acuteness of vision; "the eye of the lynx" has become proverbial; like the domestic cat, their corneas being the segment of a smaller sphere, may perhaps be considered much more convex than that of the human eye, but the perfection of their organ would seem to result from the expansive and contractile power of the iris. The immense play of the iris in the domestic cat, and the acute sensibility of the retina to light, is truly astonishing; now the owl does not possess an equal play of the iris, and we find in the broad glare of daylight they see but dimly if they see at all. There is no doubt but the pliancy or mobility of the iris may be increased by practice; we find that artizans constantly engaged in minute work, provided they do not use an artificial lens have the microscopic powers of the eye greatly increased; but the constant and long-continued action of the iris deprives it of the power of requisite contraction for distant vision; and again, sailors who are much accustomed to discern distant objects, and use their eyes a great deal by night, have their respective powers much more developed and perfect.

The pathology of the organ of vision affords a great number of facts which would seem to strengthen the opinion as it regards the influence of the iris in the proper adaptation of the eye. In the fifth vol. of the Medico-Chirurgical Review a case is related of total, though temporary blindness, attended with excessive enlargement of the pupil, and we know that sudden fear produces a similar effect upon the iris, and attended with the same defect of vision. In most cases of "iritis," indistinctness, followed by total loss of vision, commences with the irregular contractions of its muscular fibre; and after the operation for artificial pupil, when the iris has lost its powers of contraction and dilatation, the eye also loses its adaptive power, and requires the aid of artificial lenses. If the irregular contractions of the iris render vision indistinct, it would be important in the operation for artificial pupil, to take into consideration not only the requisite or most convenient diameter of the pupil, but also its form and situation; for Mr. Guthrie in his work on artificial pupil, remarks, that the more the rays of light are directed to the central portion of the lens, the powers of vision are much more augmented than when the artificial pupil is made so large that rays are admitted upon its circular margin. Indeed opticians are generally agreed that only the central portion of their lenses are of use, and by the adoption of diaphragms, they render useless, as it regards the transmission of light, any other portion. The central portion may be all that is necessary in optical instruments, as they are generally used to view single objects, or at any rate their field of vision is extremely limited, and only make use of the more parallel and direct rays. But the mechanism of the human eye gives it additional powers. Our bountiful Creator, in giving to the eye of man its powers of adaptation, enables him to survey at one glance immense portions of the universe, and under the controul of his will, by the same power can examine in detail each single object; in like manner the camera obscura possesses a great range of vision, but it possesses not the power like the eye to single out individual objects and render them more distinct. Neither the anatomy nor the physiology of the organ of sight will support the hypothesis which presumes the adaptive power to be the effect of the action of the recti muscles; in fact, this muscular apparatus connected with the eye, is designed for a motion of a different nature than that of changing the spherical form of the ball itself; it is for the preservation of the organ itself, and for the purpose of directing, under the controul of the will, the axis of the organ to the object viewed. To support the hypothesis of the four recti muscles, we must presume that they act in unison, that they all contract or relax at the same moment; this presumption, has however, never been proved by observation or experiment; but supposing they did, it would only produce the required change in the figure of the eye, when its axis was directed in a horizontal direction, directly forward; for the instant the axes of the eyes assume an oblique direction, one of the four muscles must be in a state of relaxation. But if we closely examine the motions of the eye, we will be satisfied that all the muscles do not contract simultaneously, but follow the general law of muscular action throughout the system; that is, when one muscle contracts its antagonist relaxes. It is true we have the power of contracting the two internal recti at the same time, and direct the pupil inwards towards the nose; but we have no similar power over the two external recti, and thereby to direct the axes of both eyes outwards at the same time; and it may be explained upon the difference of nervous distribution—nerves of voluntary motion being distributed to one pair of muscles, and nerves of involuntary to the other; this subject, however, has become one of so much interest, since the elucidation of the nervous system by Mr. Bell, that it should not be even referred to in so cursory a manner. If the influence of the iris is as important as it really appears to be, it will explain those changes which are observed to take place in more advanced life. As we descend in the vale of years, all the muscles, articulations, tissues, &c. become more rigid and less pliant than in youth, and there seems no reason why the muscular fibre of the iris should be an exception to this general law of nature. When the iris by age loses its activity and pliability, and no longer acts in unison with the visual sensibility of the retina, the eye is in that condition which frequently follows certain constitutional derangements, iritis, or when the operation for artificial pupil has been undergone.

Our limited knowledge of the operation of mind upon matter will not enable us to decide whether the motions of the iris are or are not wholly independent of the will, and the difficulty is still further increased by the complicated nervous distribution to the organ; there is no organ in the system to which so many different nerves are sent, and all designed for distinct functions. It receives nerves of voluntary motion from the third pair, or motores occulorum, a nerve of involuntary motion from the fourth or trochleus, branches from the fifth or ophthalmic of Willis, which is a nerve of ordinary sensation, and this last branch is joined by a nerve from the great sympathetic. In addition to these, the extreme branches of the optic nerve are freely distributed on its internal surface. To explain the sympathies consequent to this extensive nervous distribution, if it could be done, would afford matter for a distinct treatise.

If the views we have taken of the properties of the lens and the influence of the iris be correct, the mechanism by which the eye adapts itself may be better understood. The iris, by its contraction or dilatation, admits the requisite number of visual rays to pass through that portion of the crystalline lens which will cause them to reach the retina at their proper foci, while at the same time it excludes in the most effectual manner all unnecessary light, and all collateral or indirect rays. With this view of the subject, many of the anomalies of vision can be much more satisfactorily explained. The singular defect of vision which occurs occasionally to Mr. ABERNETHY, the talented professor of St. Bartholemew's Hospital, is of that description which we are rather inclined to believe should be attributed directly to the irregular contractions of the iris, though induced, it is highly probable, by a certain morbid condition of the retina. On certain occasions he can only see one-half of any object viewed; on observing himself in a mirror, but half of his face is distinctly visible; looking at his name upon the door-plate only a part of the letters are distinctly seen. A similar effect can be produced in the instrument now before me, (constructed as nearly as possible to resemble the human eye,) by bringing the opening in the artificial iris either above or below the central portion of the lens, whereby certain of the direct rays coming from the object are intercepted, and consequently only a part of the image will be distinctly painted upon the screen. The cases which Mr. Abernethy alludes to, and considers analogous to his own, are purely the result of a morbid condition of the nervous system, and cannot be explained upon the known laws of optics. The instances he quotes are those where individuals see, or rather think they see, objects that are invisible to persons around them. Such cases are by no means uncommon, and in the complaint denominated "delirium tremens" are almost a constant symptom. The case related by Mr. A. was that of a gentleman, who, while reading in his study, on turning his head, observed, as he thought, a woman in a red cloak seated in a chair near him. So complete was the illusion, that he addressed her and inquired how she came there; receiving no answer, he ordered her out of his presence, and expostulated with her for not obeying him. At length he rose from his seat, rang for his servant and ordered him to turn her out. The servant assured him that there was no woman or red cloak in his presence; he then sent for his physician, very naturally concluding that his nervous system was deranged.

Now it cannot be presumed that in this instance there were rays of light reflected from a woman in a red cloak and impinging upon the retina of his eye; but it is equally certain that at some former period all this had taken place, and that the gentleman had actually seen just such an accoutred woman, whose image upon the retina had produced a certain impression upon the sense of vision, and at the time the mind may have taken cognizance of it. At any rate, the image once upon the retina left a certain impression, which the organs constituting the sense of vision had the power to exercise and with the same degree of vividness as it had once appeared; not by a voluntary effort of the mind, because it appeared whether he would or not. He might say with Macbeth, "Avaunt and quit my sight, unreal mockery hence!" but there it remained "like the air-drawn dagger, in form as palpable as that which once he saw." In fact, we are hourly convinced that the *mind* has as limited a power of recalling *sensations* as it has in exciting or controlling the functions of the involuntary nerves. It would seem that, that portion of the brain which gives origin to the nerves of *sense*, performs its function to a *certain extent*, independent of the cerebrum, or that portion of the encephalic apparatus which is at present considered the organ or *medium* for the exercise of intellect or volition; and the mind, however it may recal its own emotions, the result of sensation, has but a limited power over the *sensation* itself.

Let the mind endeavour to picture to itself the person or portrait of an intimate and absent friend, and after the greatest exertion how faint and indistinct the picture will be when compared to that portrait which we must believe the *senses* conjure up during the partial repose of the intellect. When dreams disturb the curtained sleep, how vivid are all the sensations, and yet in what unnatural and absurd combinations do they come before the dozing mind.

> "Strange dreams, that give a dead man leave to think."

Are not these rather the offspring of the senses than involuntary aberrations of the mind? Are not the sensations of the maniac, and the perceptions arising from them, as real and substantial as though they originated from present sensations? and yet we know that the real *material* object, the sound, the smell, and the touch, that once imprinted them on the organs of sense, is not at the moment present.*

Such hallucinations, however, as those recorded by Mr. Abernethy, and others of daily occurrence, should be considered as functional derangements of the whole nervous system, and are to be accounted for or explained by the physiologist and metaphysician, while the defect in his own case is directly owing to an arrangement in the mechanism of the eye, and admits of explanation upon the known laws of optics. For in his own case there were rays of light reflected from a material body and impinging upon the retina of his eye, and we are inclined to believe that upon close examination it would be found that the irregular contractions of the iris brought the pupil in that position as it regards the lens, that the rays of light did not strike equally upon its central portion. The consequence would be that half or a portion of the rays would be intercepted, some of those admitted would be unduly refracted, the remainder would be brought to their proper foci, and that portion of the image would be distinct, the other indistinct or perhaps invisible, according to the extent of the derangement in the action of the iris.

New York, August, 1831.

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* Be this as it may, our present knowledge of mind as connected with matter, is by far too limited to lead to any certain conclusions.